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SUGGESTED EXPLANATIONS OF CERTAIN PHENOMENA IN THE LIVES OF ANTS; WITH A METHOD OF TRACING ANTS TO THEIR RESPECTIVE COMMUNITIES.

ADELE M. FIELDE.

A. During summers spent upon Cape Cod and Cape Ann, I have observed a preponderance of queen-pupæ in the nests of myrmicine and camponotine ants in the month of June, and a marked diminution or absence of such pupæ late in summer. This observation has led me to believe that queens may be the issue of eggs deposited in the preceding summer, having passed the winter in the larval stage in company with the hibernating ant-nurses. They would thus receive the earliest attention of these nurses at the beginning of the warm season and would then acquire the size and traits that distinguish them from the workers, the workers being more rapidly developed from eggs deposited during the summer in which they hatch. It is well established that the activities of the ants increase with the temperature¹ up to 85° F. or 30° C. The maximum activity of the nurses, with the more abundant food-supply in summer, should make queen-pupæ more numerous in early autumn than in early summer, were these pupæ the product of eggs deposited during the summer in which the queen-pupæ are discovered. The relative paucity of insect food, the comparative inactivity of the ant-nurses during the spring, and the brevity of the interval between the emergence of the ants from the hibernating place and the discovery of the queen-pupæ, render it fairly certain that these pupæ had attained the larval stage previous to the retirement of the ants into the deep recesses of their nest at the approach of the preceding winter.

¹ "Observations on Ants in their Relation to Temperature and Submergence," A. M. Fielde; BIOLOGICAL BULLETIN, Vol. VII., No. 3, August, 1904, and "Temperature as a Factor in the Development of Ants," A. M. Fielde, BIOLOGICAL BULLETIN, Vol. IX., No. 6, November, 1905.

B. Last summer, on Cape Ann, I kept a colony of formicid ants, that were living in their natural nest under a single stone, abundantly supplied with crushed insects, sugar, and sponge-cake, the supply being protected from rain and renewed at least twice a week. I also arranged annexes to the nest, and these proved so acceptable to the ants that they moved part of their colony into my additions to their residence. At the end of June, when I first observed this nest, there was a great number of queen-pupæ in it but no queen was visible to me. Early in July there were numerous newly hatched queens, and from that time until the eighth of September, when I left Cape Ann, the queens were countless, and there had been no observed swarming from the nest. Somewhat similar observations made by me upon other natural nests have suggested the possibility that the retention of more than one queen by certain species of ants, including *Stenamma fulvum* may result from abundance of nutriment, attainable without excessive labor on the part of the workers.

C. In my formicaries, ants of two species, *Lasius latipes* and *Camponotus herculeanus*, neither of which is a tent-builder, as well as the tent-building ant, *Cremastogaster lineolata*, have at different times protected their young from light by making, during the night, a continuous layer of small pellets of earth on the top of a pane of transparent glass, that I had placed horizontally over a hollow in which the young were assembled. Since all ants habitually withdraw their young from the ultra-violet rays of light, it appears probable that the tent-building ants erect their peculiar structures for the purpose of shielding their young from these rays; and the above recorded observations, on ants of another subfamily, indicate that specific conditions may impel other than tent-building ants to become tent-builders.

D. For correct interpretation of the behavior of ants observation needs be indefinitely prolonged. Sometimes the real animus of one ant toward another is revealed only after weeks or months of continuous association. Some ant-sisters, *Camponotus pennsylvanicus*, reared by me and indisputably the offspring of the same queen-mother, were separated all their lives, the younger in one group, and their elders by a year in another group. The two groups were gradually and cautiously made acquainted with one

another, and the younger sisters were supposed by me to have become reconciled to the progressive odor of their seniors. But after being united in an apparently congenial family group, a senior worker was occasionally killed by a junior, and successive conflicts utterly destroyed the colony after several months.

I have repeatedly observed the gradual dwindling and extinction of apparently healthy ant-groups in which the individuals bore odors not wholly familiar to all the inhabitants. Into an artificial nest of *Camponotus herculeaneus*, in which the occupants were all virgin workers, who had never before met a male of their species, I introduced several males. The first impression of an inexperienced observer would probably have been that the workers attacked the males with intent to tear them limb from limb. For some hours the attacks were maintained; but the males remained unscathed and, without even a rent in their delicate wings, continued for weeks in close companionship with the workers. It was attraction, not antipathy, that dictated the violent behavior of the workers.

The presence of young; the completeness of the establishment of the nest-aura; the domestic conditions in general; the familiarity of the ants with their immediate environment; the incurred odor; the inherited odor; the progressive odor; the specific odor; the sensitivity of the ants to a preponderating odor and their encouragement or discouragement therefrom; the aptness of ants to concentrate attention upon an immediate interest and to become temporarily oblivious to other matters; and the associative memory maintained by every ant concerning its previous experiences, are all factors which need be weighed when determining the causes of the behavior of ants.

E. When making inquiry of the ants concerning their sense of hearing in the summer of 1903, I deprived the ants of portions of their bodies and found that the excision of certain parts uniformly affected the direction of the movement of the ants when they were startled.¹ Normal queens (of *Stenamma fulvum*) moved either forward, backward or sidewise, while queens de-

¹ "The Reactions of Ants to Material Vibrations," by Adele M. Fielde and George H. Parker, *Proceedings of the Academy of Natural Sciences of Philadelphia*, November, 1904, p. 646.

prived of both antennæ invariably moved backward or sidewise, never forward, and queens deprived of the abdomen always moved forward or sidewise. Since the publication of that paper, it has appeared to me probable that the uniform differences in the direction of movement coincident with uniform maiming of the ants, might be explained by the change of the location of the center of gravity within the body of the ant. Change of the location of the center of gravity in the body of a queen upon the loss of her wings after mating may also explain certain changes observable at that period in her characteristic behavior. The retiring tendency of the queen after deälation may be due to the change in her center of gravity.

F. Dr. H. A. Parr, of New York, has mentioned to me an unpublished method used by him in tracking ants to their respective colonies. From a fleck of raw cotton he makes a minute torch-shaped ensign, colors the bluffy end in an anilin dye, and dips the hard-twisted handle into melted sugar. Ants will pick up this flag-like object, hold it by its sweet handle, and carry it homeward. Being very light and flexible, it does not greatly hinder the bearer in her progress through grasses and among stones; the brilliant pennon is easily followed by the eye of the observer; and different ants are distinguished by the different colors that they carry. This device enables the observer to track ants through long distances and to ascertain whether those discovered at a common rendezvous belong to one or to diverse communities.

NEW YORK CITY,
April, 1907.